

# NASA JOHNSON SPACE CENTER MEDICAL LICENSING OPPORTUNITIES



Innovation Partnerships Office

# AGENDA

## Licensing Opportunities

- Laboratory Technologies
- Medical Devices
- Medical Equipment
- Other



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# LABORATORY TECHNOLOGIES

# BODY FLUIDS MONITOR

- This invention relates to a process and apparatus for determining amounts of body fluids in a subject using bioelectrical response.
- Based on circuit components, the total volume of body water, the volume of extra-cellular water, the total blood volume and the total plasma volume of a subject may be calculated utilizing a sequence of measurements and processing steps.
- Potential applications include research, assessment of lean/fat body mass ratio, and quantitative assessment of edema (wounds, sprains, and kidneys) as well as surgeries and bone mineral density .

MSC-22491

Patent No.  
6,125,297

Patent  
Expiration  
02/06/2018

## **Benefits:**

- ☐ Fast
- ☐ Repeatable
- ☐ Non-invasive
- ☐ Non-radioactive

## WHOLE BLOOD STAINING DEVICE (WBSD)

- The Whole Blood Staining Device is a hand-held, self-contained device which provides a means to stain white blood cells by using monoclonal antibodies conjugated to various fluorochromes, followed by lysing and fixing the cells using a diluted commercial reagent.
- It provides a means to store whole blood safely in a refrigerator for up to 72 hours before processing and analysis.
- The invention contemplates a simple, self-contained apparatus for reacting the cells in biological fluids with cell marker identifiers and stabilizing the reacted sample for transport and further processing.

MSC-22614

Patent No.  
6,110,730

Patent  
Expiration  
Date

06/26/2016

### **Benefits:**

- ❑ Simple
- ❑ Hand-held device
- ❑ 72-hour storage



# PRESERVATION OF LIQUID BIOLOGICAL SAMPLES

- The preservation technology was developed to support bioastronautics research and health care needs in space.
- The technology allows storage of biological samples for clinical and biomedical research and operations in space without demands on electrical power by eliminating the need for refrigeration.
- A variety of liquid biological samples including, but not limited to, tears, urine, serum, sweat, vaginal fluids, semen, feces, mucous, lymph, breast milk, ascites, pleural effusion, synovial fluid, bone marrow, spino-cerebral fluid, and washings from bodily cavities (e.g., lung washings) can be preserved.

MSC-22616

Patent No.

6,716,392

6,133,036

Patent  
Expiration

1/14/2018

Partial License  
Available

## Benefits:

☐ Kit for  
preservation

☐ No  
refrigeration

☐ Edible  
preservative

☐ Can be used  
w/ Solid, Liquid,  
or Paste matter

PRESERVATION TECHNIQUE

Inventor  
Available

# BLOOD PUMP BEARING SYSTEM

- Methods and apparatus are provided for a blood pump bearing system within a pump housing to support long-term high-speed rotation of a rotor with an impeller blade having a plurality of individual magnets disposed thereon to provide a small radial air gap between the magnets and a stator of less than 0.025 inches.
- The present invention relates to a ventricle assist device having a bearing system for supporting long-term high speed rotor rotation with minimal friction and heat build-up.
- The rotary pump has pump blade geometry optimized by a method of the present invention to provide high pump efficiency while minimizing hemolysis and thrombus (hemolysis is defined quantitatively hereinafter).
- The pump requires less than 10 watts of power to pump 5 liters/minute against a pressure head of 100 mm Hg. A preferred embodiment of the pump weighs 53 grams and has a length of 75 mm and a diameter of 25 mm.
- An index of hemolysis of from 0.003 to 0.005 g/100 liters pumped has been achieved, although using the method of this invention, further reductions are possible.

MSC-22721

Patent No.

5,957,672

6,254,359

6,135,729

Patent

Expiration Date

11/10/2013

## Benefits:

☐ Improved rotor control system

☐ Low index of hemolysis

## IN-VIVO BUBBLE SIZING INSTRUMENTATION

- Method and apparatus are provided for a non-invasive bubble measuring instrument operable for detecting, distinguishing, and counting gaseous embolisms such as bubbles over a selectable range of bubble sizes of interest.
- In-vivo measurement of the size and number of bubbles in fluids and tissues may be used to prevent, diagnose, and/or treat many potentially serious medical conditions such as, for example only, decompression sickness or stroke following cardiopulmonary bypass procedures.

MSC-22980

Patent No.

6,463,785

6,629,449

6,467,331

Patent  
Expiration Date

3/26/2022

### Benefits:

- ☐ Non-invasive
- ☐ Bubble size recognition
- ☐ Emboli Determination



## MICROMECHANICAL OSCILLATING MASS BALANCE (MOMB)

- The MOMB is a very small device for measuring mass or weight that measures mass on the order of  $10^{-8}$  grams, such as during a vapor deposition process.
- The invention comprises a vibratory composite beam which includes a dielectric layer sandwiched between two conductive layers. The beam is positioned in a magnetic field.
- An alternating current passes through one conductive layers, the beam oscillates, inducing an output current in the second conductive layer, which is analyzed to determine the resonant frequency of the beam.
- As material is deposited on the beam, the mass of the beam increases and the resonant frequency of the beam shifts, and the mass added is determined.

MSC-22569

Patent No.  
5,684,276

Patent  
Expiration Date  
12/12/2015

### Benefits:

- design simplicity
- low excitation frequency
- Portability
- High sensitivity
- Ruggedness
- low susceptibility to thermal errors

## SOFT-SIDE AIR DISPLACEMENT VOLUMOMETER

- This is a device and method to measure the volume of a person's body, limb, or other solid object using a soft-sided bag, air injector, pressure transducer, and recording device.
- Through the use of the pressure transducer and recording device while pressurizing subject measured, the volume can be derived.
- The volumometer may easily be used in hospitals, medical offices, health clubs, and space flights.
- The bag can be collapsed or folded into a small volume for ease of storage and portability.

MSC-22653

Patent No.  
5,948,977

Patent  
Expiration  
Date  
03/31/2018

### **Benefits:**

- ☐ Portable
- ☐ Inexpensive
- ☐ Accurate

## URINE PRESERVATIVE WITH ANTIBACTERIAL AND ANTIOXIDANT

- The Urine Preservative with combined antibacterial and antioxidant properties preserves urine analytes at ambient temperatures for extended periods of time.
- It also eliminates or reduces the primary causes of analyte destruction in urine and bacterial contamination and oxidation.
- Only 0.4 mg/liter of the preservative is required to preserve one urine sample.
- The non-toxic and non-acidic preservative can also be used to preserve urea, ammonia, 3-methylhistidine, nitrogen, calcium, sodium, potassium, and chloride for extended periods.

MSC-22695

Patent No.

6,261,844

Patent  
Expiration  
Date

12/17/2018

### Benefits:

- ❑ No refrigeration required
- ❑ pH level conserved
- ❑ Anti-microbial
- ❑ Antioixdant

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# **MEDICAL DEVICES**



# DIRECTIONAL MICROWAVE APPLICATOR/ ANTENNA

- A miniature microwave antenna is disclosed which may be utilized for biomedical applications such as, for example, radiation induced hyperthermia through catheter systems.
- One feature of the antenna is that it possesses azimuthal directionality despite its small size. This directionality permits targeting of certain tissues while limiting thermal exposure of adjacent tissue.
- One embodiment has an outer diameter of about 0.095" (2.4 mm) but the design permits for smaller diameters.
- Because of the small diameter, circumference, or periphery, the present invention may also be used as a catheter, syringe, and/or cannula antenna.

MSC-23781

Patent No.  
7,410,485

Patent  
Expiration Date  
01/14/2025

## **Benefits:**

- ☐ Multi-purpose application
- ☐ Small size
- ☐ Microwave Energy

## MICROWAVE TREATMENT FOR CARDIAC ARRHYTHMIAS

- Method and apparatus are provided for propagating microwave energy into heart tissues to produce a desired temperature profile therein at tissue depths sufficient for thermally ablating arrhythmogenic cardiac tissue
- Treats ventricular tachycardia and other arrhythmias while preventing excessive heating of surrounding tissues, organs, and blood.
- The microwave ablation apparatus consists of three components – microwave generator, flexible coaxial cable, and microwave radiator.

MSC-22483

Patent No.

5,904,709

6,175,768

6,134,476

Patent

Expiration Date

04/17/2016

### Benefits:

- ☐ Effective cure
- ☐ Low manufacturing complexity
- ☐ Minimal training
- ☐ Non-traumatic
- ☐ Cost effective

Inventor  
Available

# ENDOTHELIUM PRESERVING MICROWAVE TREATMENT FOR ATHEROSCLEROSIS

- Method and apparatus are provided to treat atherosclerosis wherein the artery is partially closed by dilating the artery while preserving the vital and sensitive endothelial layer thereof.
- Microwave energy having a frequency from 3 GHz to 300 GHz is propagated into the arterial wall to produce a desired temperature profile therein at tissue depths sufficient for thermally necrosing connective tissue and softening fatty and waxy plaque while limiting heating of surrounding tissues including the endothelial layer and/or other healthy tissue, organs, and blood.

MSC-22724

Patent No.

6,047,216

6,226,553

6,223,086

6,496,736

Patent  
Expiration Date

08/05/2018

## Benefits:

- ☐ Small size
- ☐ Non-invasive
- ☐ Reduced treatment time
- ☐ No scar or damaged blood vessel walls

Inventor  
Available



# MICROWAVE ABLATION OF PROSTATIC CELLS USING A SEPARATED ANTENNA ARRAY

Prototype  
Available

- Procedure, apparatus, and computer simulations designed to radiate energy into body tissue, and that is especially effective for treating benign prostatic hyperplasia (BPH)
- Deep heating of tissue without damaging healthy tissue, urethra, or other adjacent organs.
- Uses microwave energy to produce the desired heating profile by utilizing constructive and destructive interference of microwave transmission from the first microwave antenna to the second; this allows for a desired heating profile

MEDICAL DEVICES

MSC-23427

Patent No.  
6,944,504

Patent  
Expiration Date  
2020  
2022

## Benefits:

- ☐ Reduces tissue damage
- ☐ Less painful
- ☐ Customization capability
- ☐ Reduced Energy

Inventor  
Available



# MICROWAVE TREATMENT SYSTEM FOR PROSTATE CANCER AND HYPERPLASIA

## PART II

- This invention is conceptual and uses a microwave energy system, catheter (coaxial cable), and antenna to treat hyperplasia and prostate cancer.
- By heating the abnormal prostate area cells you can ablate them
- Two insertion techniques can be used for treatment:
  - Catheter can be placed in the urethra to directly treat the prostate, or
  - A directional antenna can be placed in the colon and radiated toward the prostate.
- Treatment through the colon is possible because prostate cancer often begins in areas that can easily be heated through the colon's membrane.

MSC-23049

Patent No.

6,289,249

6,512,956

6,675,050

6,592,579

Patent Expiration  
Date

2020

2022

### Benefits:

- New business for Electrophysiologist
- Less painful
- Less intrusive
- Lower Cost

# HEART PUMP OUTFLOW CANNULA COUPLING

- A fluid coupling has been developed for use in securing a vascular outflow graft (cannula) to the outlet of a surgically implanted NASA DeBakey heart-assist pump.
- Design of coupling can be adapted to other applications in which it is necessary to join flexible tubes with rigid ones. A joint famed by use of this coupling is separable, yet free of leaks; this is advantageous in that
  - (1) it is necessary to be able to install or remove a pump in accordance with requirements for surgery, sterilization, and pump maintenance, but
  - (2) seepage of blood from an installed pump/cannula joint cannot be tolerated.

MSC-22865

Patent No.  
6,050,987

Patent Expiration  
Date:  
9/21/2018

## Benefits:

- ❑ Free of leaks
- ❑ Helps prevent clotting
- ❑ Tapered and threaded surfaces
- ❑ smooth fluid transition
- ❑ Manufacturing friendly

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# **MEDICAL EQUIPMENT**

# LASER DIRECTED RANGING SYSTEM FOR TELEROBOTICS APPLICATIONS

Prototype  
Available

- Technology could aid physically handicapped individuals. It could be mounted upon a wheel-chair vehicle fitted with a robotic arm for grasping objects.
- Technology used to determine the distance from a remote-controlled robot to another object, operator controlled through a robot-mounted camera platform using a position-sensor helmet.
- Position signals from the helmet sensors are sent to the camera platform, enabling the movement of the camera platform to mimic the movement of the operator's head.
- The technology developed by NASA is relatively inexpensive and provides the desired accuracy through the use of a fairly simple range-finding process.
- The range-finding process of this system is voice actuated and allows an operator to perform all the required activities "hands free"

MSC-22431

Patent No.

5,684,531

Patent  
Expiration Date

04/10/2015

## Benefits:

- Non-Complex Algorithms
- Improved stereometric ranging system
- Hands-free targeting
- Low Cost



## DESIGN CONCEPT FOR LOAD SELECTABLE CONSTANT LOAD DEVICE FOR THE SUBJECT LOAD DEVICE (SLD) AND RESISTIVE EXERCISE (RED) FOR ISS

- An exercise device is particularly well suited for use in low gravity environments, and includes a frame with plurality of resistance elements, supported in parallel on the frame.
- The load transfer member is moveable relative to the frame for transferring the applied force to the free end of each captured resistance element.
- Exerts substantially the same coupling force regardless of how the person moves.
- Provides a constant force independent of stroke velocity throughout the outward (extend) and inward (return) components of the stroke.
- The load devices are adjustable, so that the person can accurately and consistently select the amount of force to be exerted.

MSC-23196

Patent No.

6,958,032

Patent  
Expiration Date

09/26/2022

### Benefits:

- ☐ Simple
- ☐ Reliable
- ☐ Compact
- ☐ Lightweight
- ☐ Attach to treadmill

## ARTICULATING SUBJECT SUPPORT FOR RESISTIVE EXERCISE IN THE HORIZONTAL POSITION

- An apparatus and method for exercising whereby the user is supported by various mechanisms in such as way that the user's shoulder area is free to translate and rotate; the user's pelvic area is free to translate and rotate; or in any combination.
- This invention relates to an exercise device that closely simulates a free-weight squat movement.
- The various embodiments of the apparatus afford a capability for selectively loading and unloading of portions of the user's body through its support mechanisms
- Technology promises to be useful in bed-rest studies, strength training, physical therapy and rehabilitation, and the like.

MSC-23594

Patent No.

7,125,370

Patent

Expiration Date

05/12/2024

### Benefits:

- Free-weight squat movement
- Selective loading & unloading
- Injury Rehabilitation
- Selective Athlete training

# ADVANCED RESISTIVE EXERCISE DEVICE (ARED)

Prototype  
Available

- Designed to maintain muscle and bone density as well as improve physical strength and endurance.
- It consists of three pieces : a resistive exercise device, an advanced resistive exercise device and articulating support for horizontal resistive exercise.
- An exercise device that includes a vacuum cylinder and a flywheel. The flywheel provides an inertial component to the load, which is particularly well suited for use in space as it simulates exercising under normal gravity conditions.
- The exercise equipment can be used as a home gym, rehabilitation and physical therapy purposes, and an exercise device for a health club, hotel, or cruise ship.

## EXERCISE EQUIPMENT

MSC-23805

Patent No.

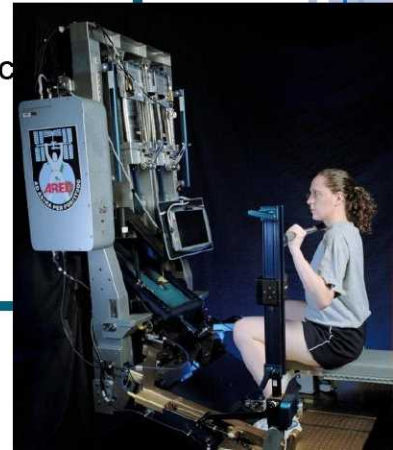
7,462,141

Patent Expiration  
Date

01/06/2025

### Benefits:

- ☐ Compact
- ☐ Relatively low mass
- ☐ Load adjustable
- ☐ Minimal maintenance
- ☐ Height adjustable



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## OTHER TECHNOLOGIES



# DEVELOPMENT OF A UNIDIRECTIONAL CELL STRETCHING DEVICE

Prototype  
Available

- The device seeks to provide a mechanically active tissue culture environment that mimics the mechanical load profiles encountered within muscle tissue in vivo and allows real-time monitoring of cells grown in the vessel.
- Designed to produce only linear stretch. It permits easy removal of the cells at the end of the loading experiment for microscopic examination or biochemical analysis.
- This stand-alone device functions as a sealed unit, thus permitting intra-vessel pressures to be altered within ranges found with muscle tissue in vivo, mimicking changes in hydrostatic pressures encountered during muscle contraction in the whole animal.
- The device is capable of mimicking the linear load profiles placed on skeletal muscle within the human body. Also, the ability to remove mechanical load allows the study of the effects of unloading alone or unloading/reloading to be studied.

MSC-22834

Patent No.

6,107,081

Patent

Expiration Date

02/05/2019

## Benefits:

- Several design modifications possible
- Stand alone and sealed unit
- Mimics hydrostatic pressures and linear loads
- 3-dimensional environment
- Unilateral stretch

## THREE DIMENSIONAL OPTIC TISSUE CULTURE AND PROCESS

- Provides an alternative to the use of donor tissue in cornea transplantation by artificially producing three-dimensional optic tissue.
- The method uses the patient's own cells or from donor to form corneal tissue matrices in vitro for implantation.
- The optic cells are cultured in a bioreactor at low shear conditions.
- The tissue forms as normal, functional tissue grows with tissue organization and extracellular matrix formation.

MSC-22368

Patent No.

5,962,324

Patent  
Expiration  
Date

10/05/2016

### Benefits:

- No artificial architecture
- Cells exhibit normal cell characteristics
- Formation of extracellular matrix

Inventor  
Available

# PULSE-FLOW MICROENCAPSULATION SYSTEM AND METHOD

- Microencapsulation is a process in which tiny particles or droplets, generally between 1-500 microns in diameter, are surrounded by a coating to produce small capsules or microcapsules with many useful properties.
- This is an automated system that continuously produces a stream of liquid-filled microcapsules for delivery of drugs or other therapeutic agents.
- Is a single, microprocessor-controlled system that performs all processing steps, including acquisition of quality-control data.

MSC- 23659

Patent No.  
7,094,045

Patent  
Expiration Date

6/9/2024

## **Benefits:**

- Single, microprocessor-controlled system
- All steps in one
- Quality control can use real time feedback



If you would like to learn more about these technologies please contact:

Sonia Hernandez-Moya  
Life Science Integration Manager  
281-483-1752

[isc-techtran@mail.nasa.gov](mailto:isc-techtran@mail.nasa.gov)

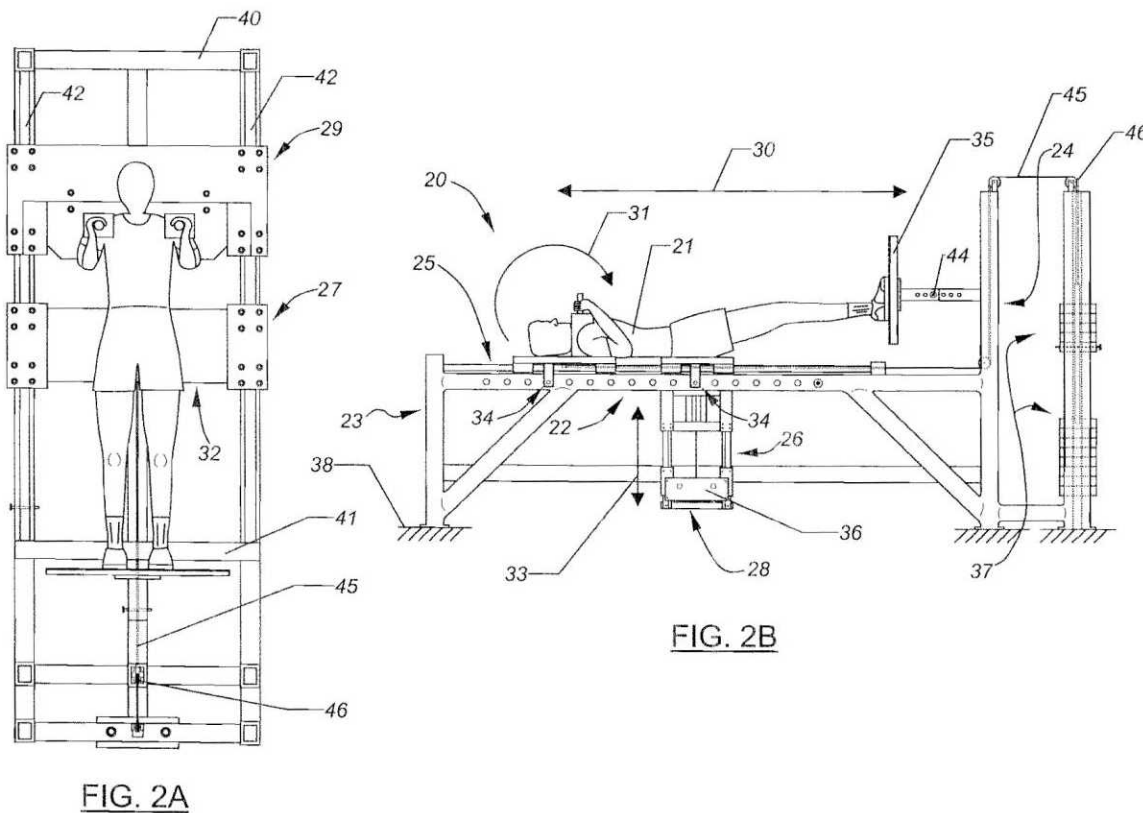
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Mail Code AF2  
Houston, TX 77058



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## BACK-UP SLIDES

# MSC-23594 EXERCISE APPARATUS



MSC-23594-1 Sheet 2 of 6  
 Title: Exercise Apparatus  
 Inventors: Grant Schaffner, et al.  
 For any questions, please contact Theodore U. Ro at 281.244.7148

Certificate of Mailing # 3478981US

# MSC-23594 EXERCISE APPARATUS

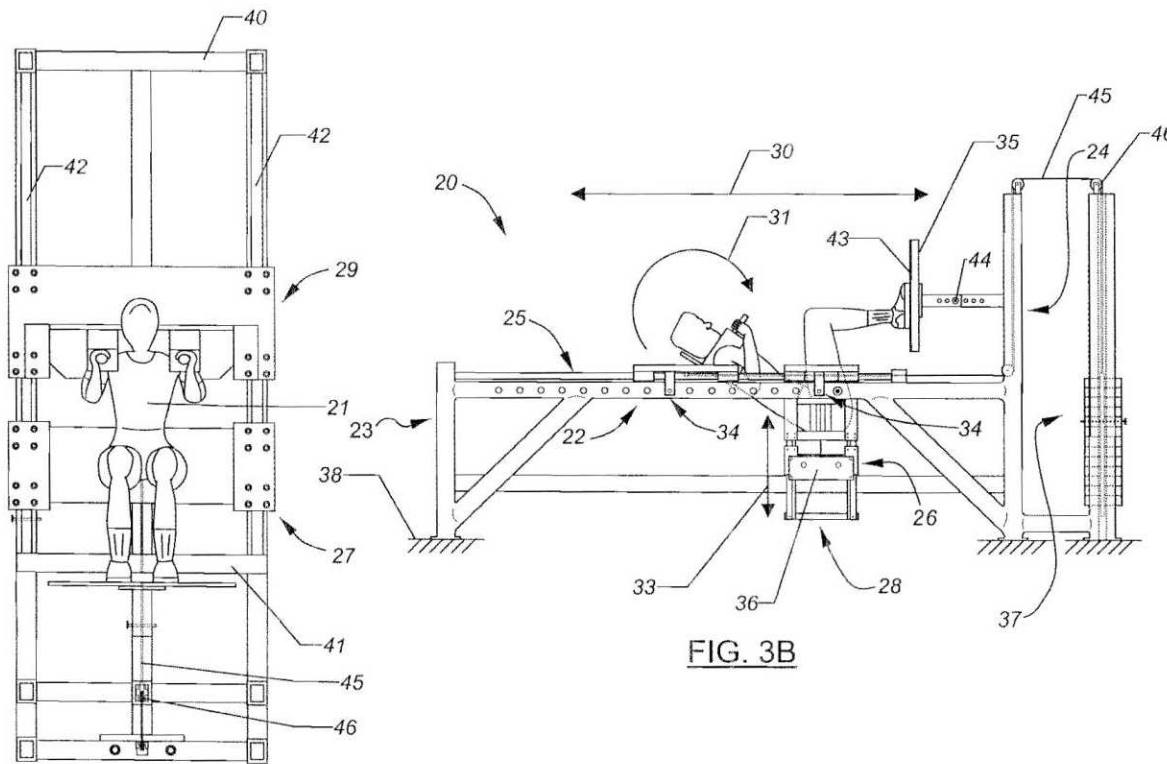


FIG. 3A

FIG. 3B

MSC-23594  
 Title: Exercise Apparatus  
 Inventors: Grant Schaffner, et al.  
 For any questions, please contact Theodore U. Re at 281-244-7148

Sheet 3 of 6

Certificate of Mailing #E165766



# MSC-23594 EXERCISE APPARATUS

MSC-23594 Sheet 6 of 6 Certificate of Mailing #E-11647898US  
Title: Exercise Apparatus  
Inventors: Grant Schaffner, et al.  
For any questions, please contact Theodore U. Re at 281-244-7148

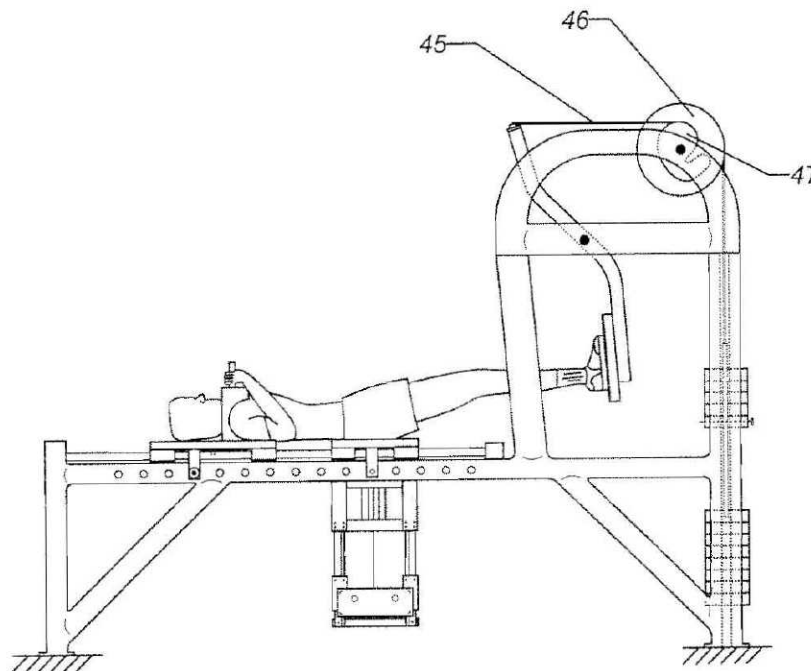


FIG. 6

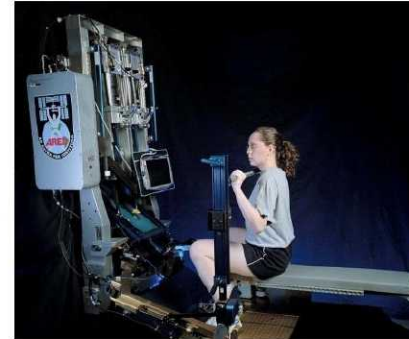




NASA-JSC BioSciences

## Resistive Exercise Technology for Space Proves Irresistible Here on Earth

Studies have shown that between the ages of 20 and 70, there is an average 30% decline in muscle strength and a 40% reduction in muscle area.\* Resistive strength exercise is a proven method to increase muscle mass for women and men, young and old. Regardless if you're in space, or right here on earth, we need muscle strength in order to live our daily lives. Resistive technology equipment is well-known not only for its rehabilitation use, but also used for high level athletic training and general fitness.



### Opportunities to License NASA Technology: Resistive Exercise Technology

NASA's resistive exercise technology is designed to maintain muscle and bone density, as well as improve physical strength and endurance in space, and is now available here on earth. The technology translates well to life on earth for potential licensees in the fields of medical rehabilitation, fitness, athletic training and general healthcare. The technology consists of three pieces of equipment -- a resistive exercise device; an advanced resistive exercise device; and an articulating support for horizontal resistive exercise. All three pieces of equipment are more compact than existing equipment.

The resistive exercise device, which is near prototype stage, is a versatile machine that can be used to perform various customized exercises that previously required separate machines. The user can perform the three primary resistive exercises for stimulating bone regeneration; along with 15 other exercises for secondary muscle groups,

including squats, dead lifts, heel raises, arm flies and hip abductions.

NASA scientists originally created the exercise technology to offset the adverse effects of long-term microgravity exposure, including muscle atrophy and loss of bone mineral density. However, the devices are adaptable to home and commercial use. Other potential uses include physical therapy and rehabilitation, as well as use at health clubs, hotels and on cruise ships. This exercise equipment is economical and durable, and provides a consistent, constant force both on the outstroke and the return stroke, similar to free-weight training.

Those parties interested in licensing this NASA-JSC technology should contact the Technology Transfer Office at 281.483.3809, [jsc-techtrans@nasa.gov](mailto:jsc-techtrans@nasa.gov) or visit <http://technology.jsc.nasa.gov>.

\*Exerc Sport Sci Rev. 1993;21:65-102. [http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list\\_uids=8504850&dopt=Citation](http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=8504850&dopt=Citation)

#### About NASA-Johnson Space Center Technology Transfer Office

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